Figure 1

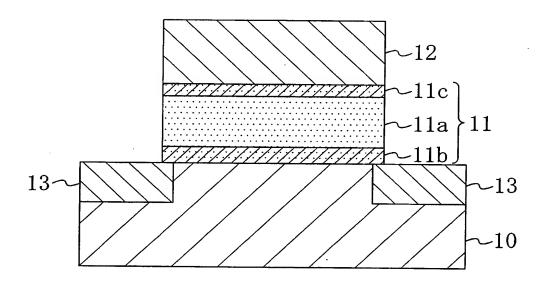


Figure 2

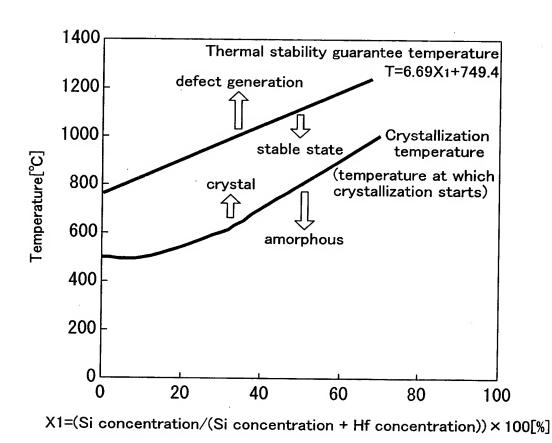


Figure 3

Α	В
750	≧0.1
800	≧7. 6
850	≧15.0
900	≧23. 0
950	≧30.0
1000	≧37. 5
1050	≧ 45. 0
1100	≧52. 4

A:Maximum process temperature

B:Practical range of

(Si concentration /(Si concentration + Hf concentration)) \times 100[%], in which the thermal stability of Hf silicate can be ensured.

Figure 4

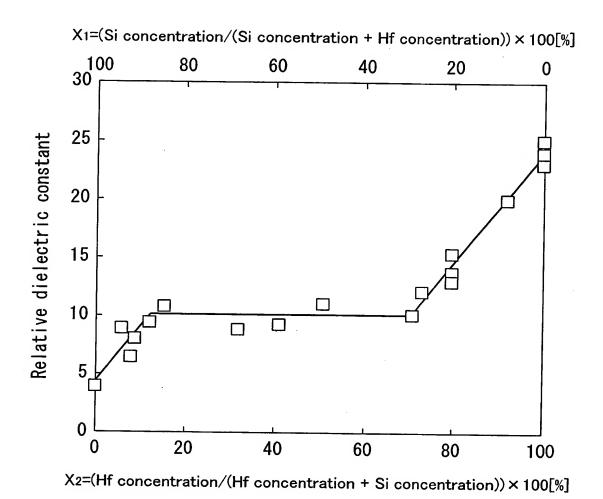
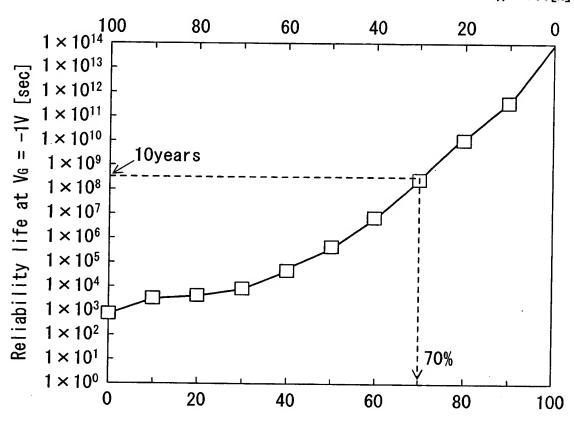


Figure 5

X1=(Si concentration/(Si concentration + Hf concentration)) \times 100[%]

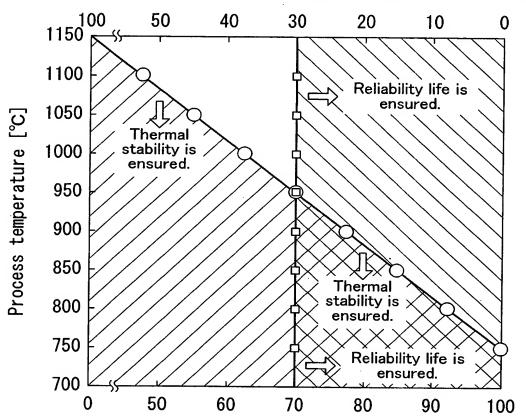


 X_2 =(Hf concentration/(Hf concentration + Si concentration)) × 100[%]

Eox(real)model
EOT=1.5nm
Incidence of failure=100ppm
MOS area =0.1cm²
Temperature=100°C

Figure 6

X1=(Si concentration/(Si concentration + Hf concentration)) \times 100[%]



X2=(Hf concentration/(Hf concentration + Si concentration)) × 100[%]

--:Thermal stability line
--:Reliability life line
:Region in which only the thermal stability is ensured.
:Region in which only the reliability life is ensured.
:Region in which both the thermal stability and the reliability life are ensured.

Figure 7A

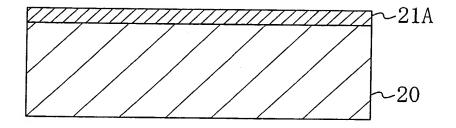


Figure 7B

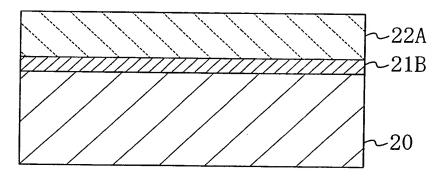


Figure 7C

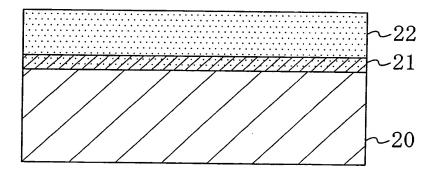


Figure 8A

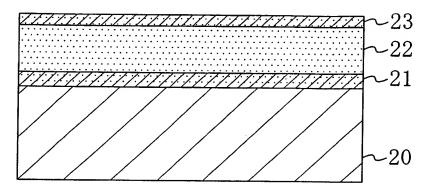


Figure 8B

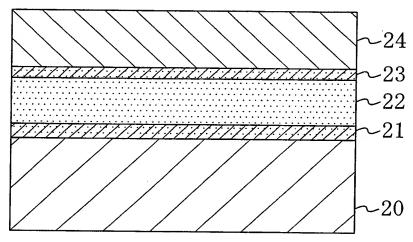


Figure 8C

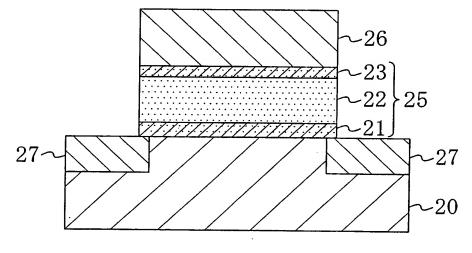


Figure 9A

[before PDA]

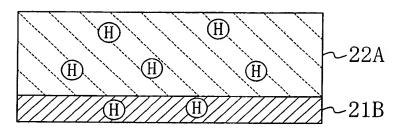


Figure 9B

[700°CPDA→hydrogen desorption]

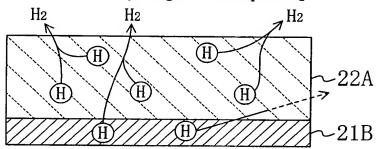


Figure 9C

[vacancy formation]

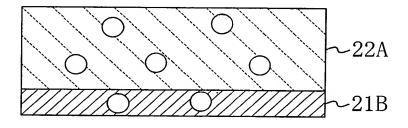
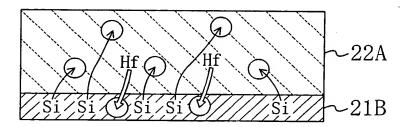


Figure 9D

[Hf diffusion + Si diffusion]



Spectrum intensity of H2 gas measured by TDS [arbitrary unit]

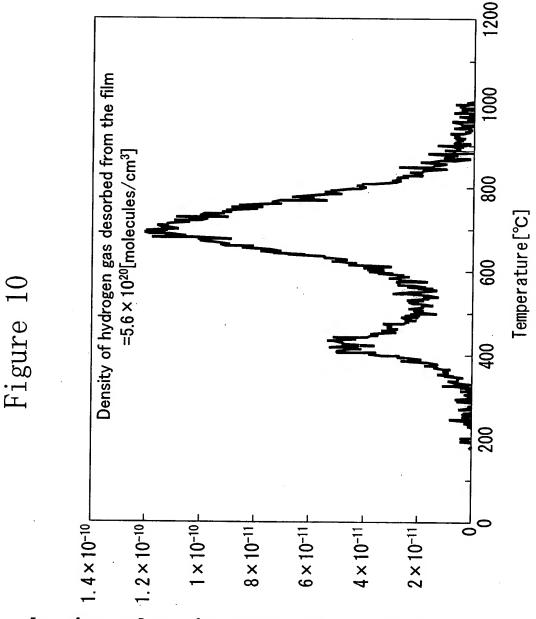


Figure 11

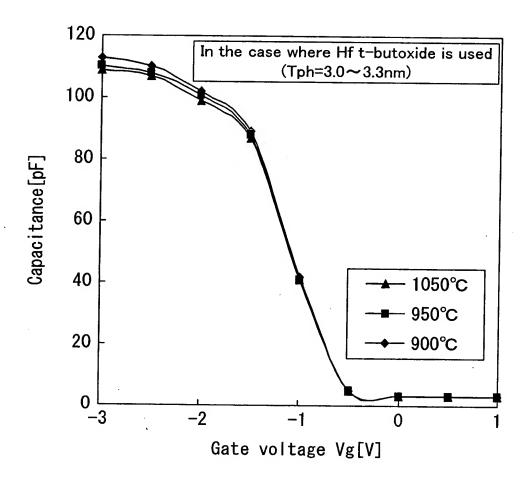


Figure 12

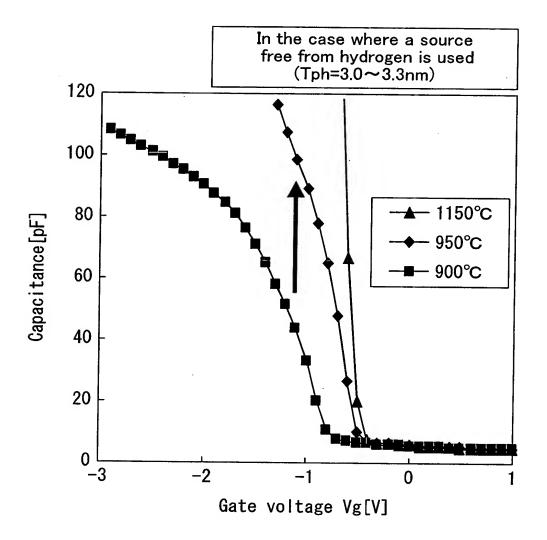


Figure 13

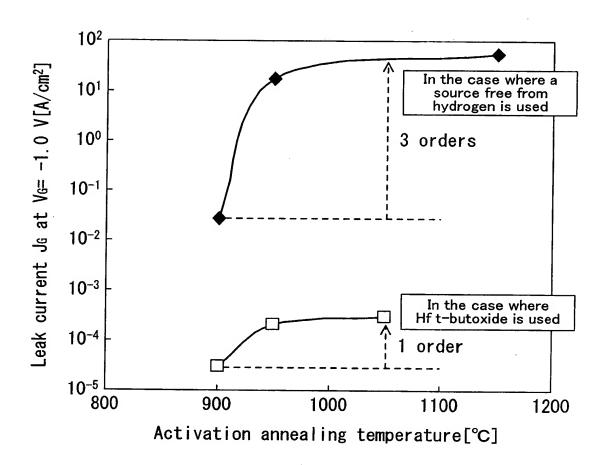


Figure 14

